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Methodology for Validation of ADS Reports

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Background(1)

- ATS systems updates aircraft positions with ADS reports.

- ATS datalink operation in oceanic ATC has experienced occasional missing or abnormal ADS reports, disturbing to present correct flight path.

Background(2)

- **ATC operation requests ADS position data to be verified.**
- **As a solution to help validate ADS reports in the ground side, a practically applicable methodology is developed.**

Validation of ADS reports

Prediction of flight route and position

- Extrapolation to predict aircraft movement and flight route are obtained with ADS reports.
- Modeling flight route is based on the great circle through estimated aircraft position.
- Position of aircraft is processed by a quaternion expression of earth bounded flight route.

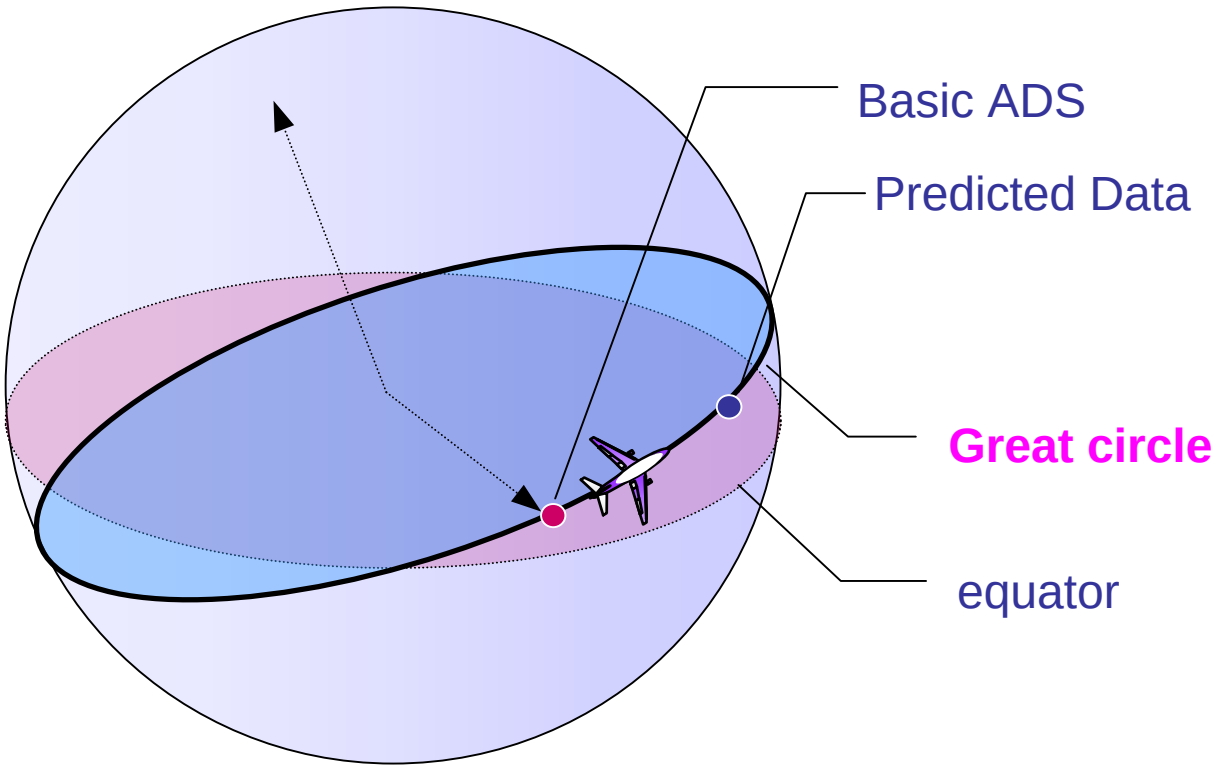
Validation of ADS reports

- Compare/verify data between consecutive ADS reported positions and the extrapolated position.

Prediction Method

Great circle representing flight path

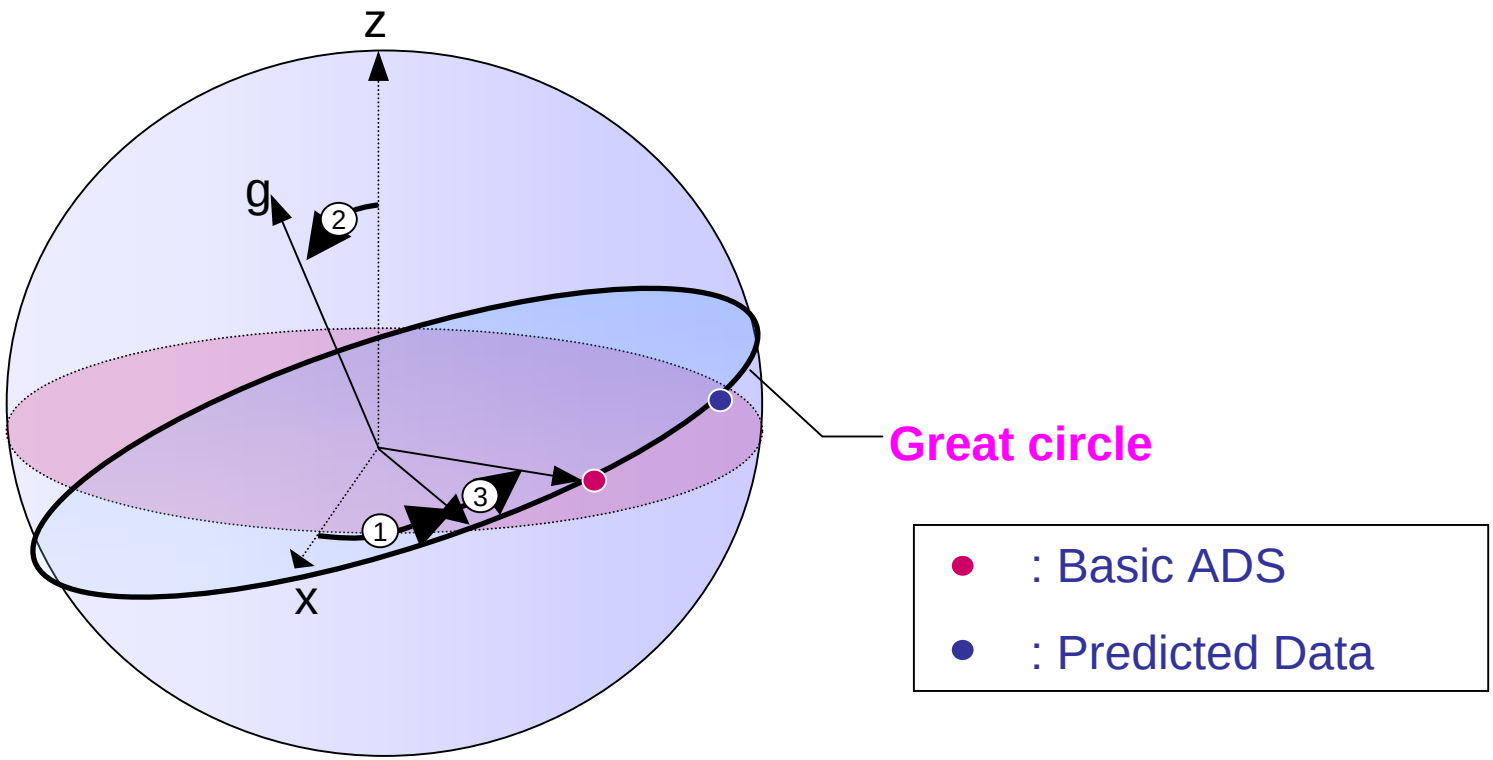
Connect Basic ADS and Predicted route group in the ADS report, and create a great circle.



Quaternion expression

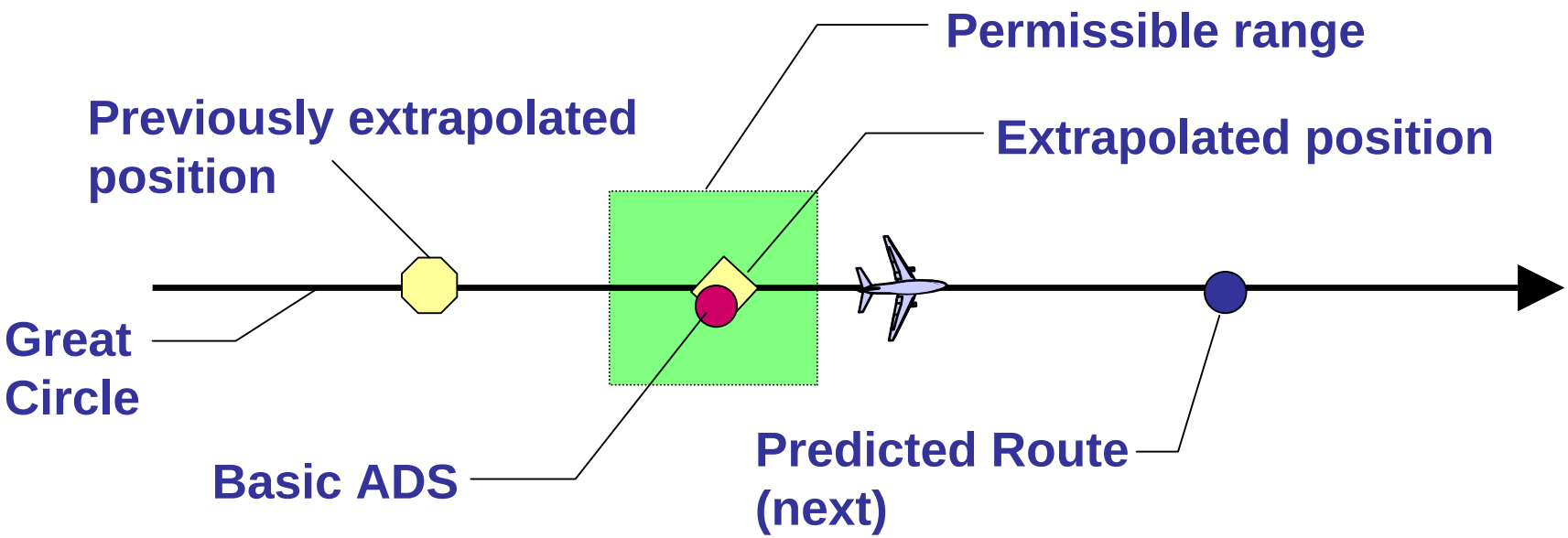
Coordinate rotation

1. Rotate x axis (Greenwich meridian) to ascending node of great circle .
2. Rotate z axis (polar axis) to axis of great circle (g vector).
3. Rotate x axis to position of Basic ADS.



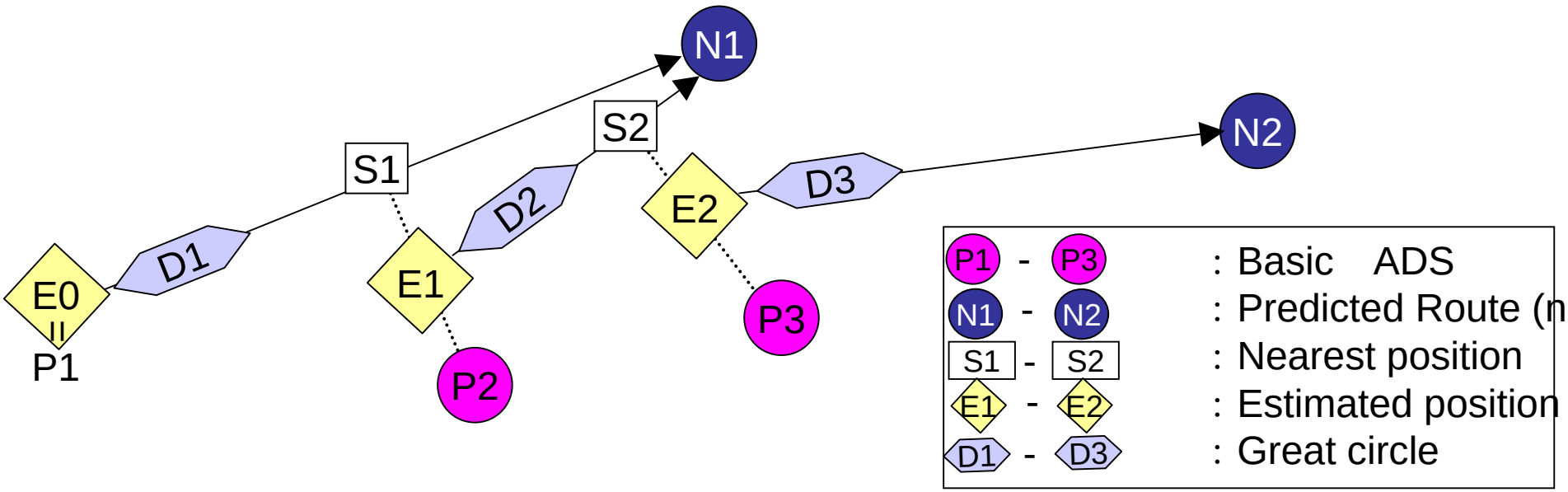
Validation of ADS report

Verify the aircraft position in ADS report by comparing extrapolated position with downlinked position, taking into account a permissible range.



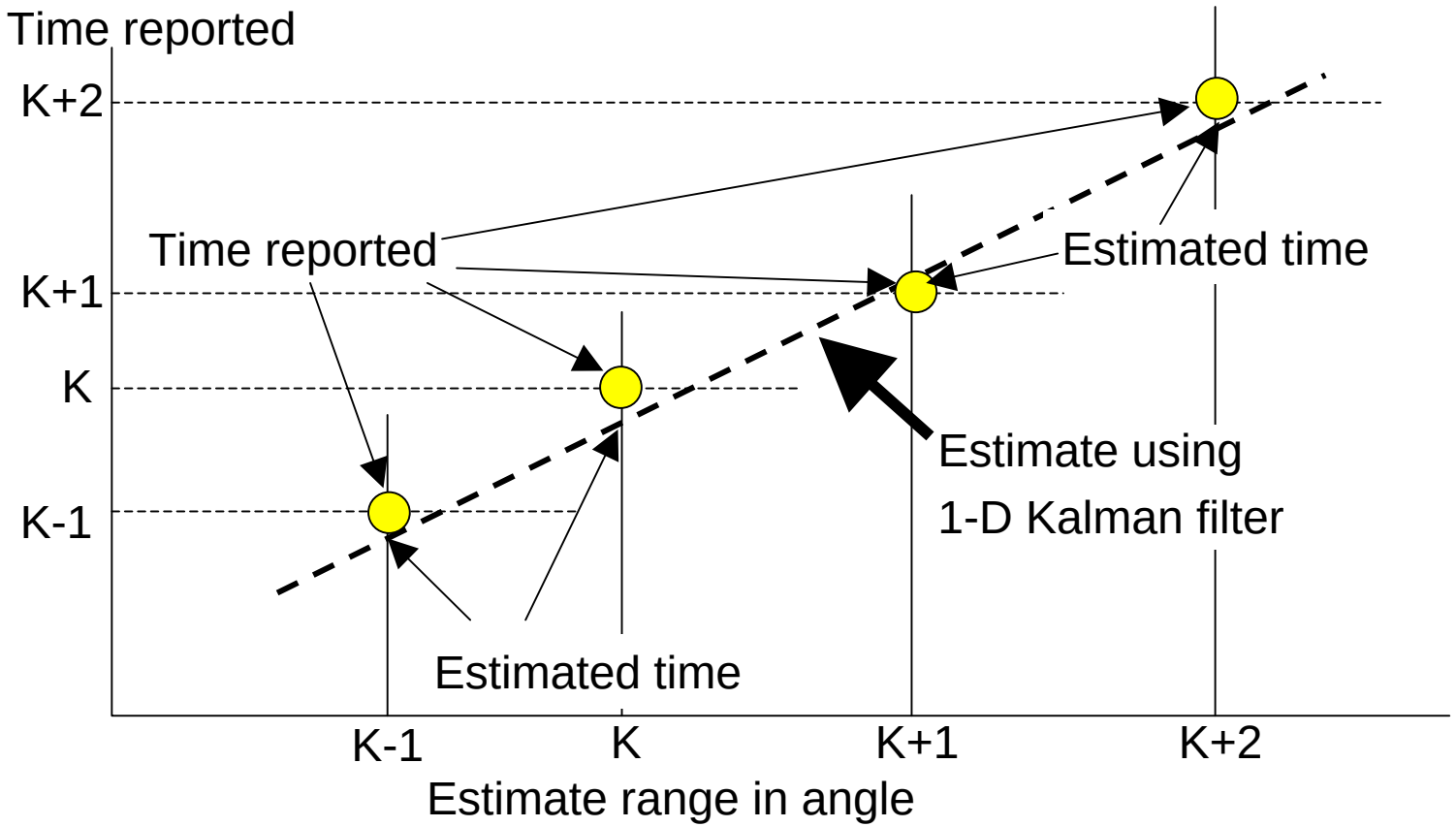
Estimate of position

- Great circle (D1) connecting Basic ADS (P1) with Predicted route (next) (N1) .
- Extrapolated position (S1) on the Great circle, and estimate position (E1) based on moving average.
- New Great circle (D3) connecting Estimated position (E2) with Predicted route (next) (N2).



Estimated time and velocity of aircraft

Estimate time by 1-D Kalman filter.



Conclusion

With use of this extrapolation methodology, oceanic air traffic controllers are provided with uninterrupted update of aircraft flight path and positions by ATS system, even if an ADS periodic report is missing or contains unreliable positional data.